idw - Informationsdienst Wissenschaft
Nachrichten, Termine, Experten

Press release

Rheinische Friedrich-Wilhelms-Universität Bonn
Svenja Ronge

03/27/2023
http://idw-online.de/en/news811512

Personnel announcements, Research projects
Information technology, Physics / astronomy
transregional, national

On the trail of the big questions of particle physics: new Clausius Professor at the University of Bonn

The matter and energy we know make up only five percent of the cosmos; but what is the remaining "dark matter" and "dark energy" made of? Why is there so much matter but so little antimatter in the universe? And why do the neutrinos have such tiny masses? To answer these fundamental questions, the new Clausius Professor Jun.-Prof. Dr. Lena Funcke and her team are developing models beyond the Standard Model of particle physics and applying novel computational methods. This will be a new research focus at the University of Bonn in the Transdisciplinary Research Area "Building Blocks of Matter and Fundamental Interactions".

Science works to understand complex phenomena, such as the formation of galaxies or the truths hidden in the enormous amount of data generated by experiments in a particle accelerator. Pen and paper are often not sufficient, so sophisticated computational methods are needed. The 28-year-old Jun.-Prof. Dr. Lena Funcke and her team develop such methods, designing new approaches and leveraging existing ones in new ways. Interdisciplinary collaboration with researchers from physics, computer science, and mathematics is at the core of her process.

"We are both glad and proud, that we have succeeded to hire Lena Funcke," says Prof. Dr. Ulrike Thoma, founding spokesperson of the TRA "Matter" of the University of Bonn. "Computational methods, such as those advanced by Lena Funcke in the field of quantum field theory, are across disciplines essential if we want to understand nature with all its fascinating aspects in detail."

Excellence professorships at the interfaces of disciplines

The TRA "Matter" is one of six transdisciplinary research areas that are a cornerstone of the Excellence University of Bonn. In the TRAs, researchers work together across subject and faculty boundaries on central scientific, technological, and societal future topics.

The heart of the concept are special professorships designed to connect different disciplines. One of these professorships is the Clausius professorship in the TRA "Matter", named after the Bonn physicist Rudolph Clausius (1822-1888), which is now occupied by Lena Funcke.

Prof. Dr. Andreas Zimmer, Vice Rector for Research and Early Career Researchers, is pleased with the appointment: "Lena Funcke has already made important contributions to physics. We believe that she will enrich the excellent scientific environment of the University of Bonn and provide further important insights into the elementary processes of nature through her work."

Developing new models and methods

To answer the fundamental questions of particle physics, new models beyond the Standard Model of particle physics are needed. In her previous research, Lena Funcke has already uncovered new paths here, including the development of a model to explain the tiny masses of neutrinos. The model predicts that the masses of neutrinos do not arise directly after the Big Bang, like the masses of other elementary particles, but rather very late in the history of the universe. If the model is verified experimentally, it has crucial consequences for our understanding of the late development of the universe.

To build predictions about the experimental results from models within and beyond the Standard Model, complicated calculations are necessary, which often require new computational methods. For this, Lena Funcke and her team develop algorithms which run on standard computer architecture, based on lattice quantum field theory, tensor networks, and machine learning ("artificial intelligence"). She and her team also work on developing algorithms for quantum computers.

While standard computers operate with bits that can only assume the states 0 or 1, quantum computers operate with so-called qubits, which can also be simultaneously in the state 0 and 1 or theoretically in infinitely many states in between. Due to this property, quantum computers have the potential to enable calculations beyond what today's computers are capable of. "Many of these computational methods have applications beyond particle physics, for example, to problems in quantum chemistry or optimization problems at airports," explains Lena Funcke.

"The University of Bonn with its transdisciplinary research areas offers the perfect environment for my interdisciplinary research projects," says Lena Funcke. "I am looking forward to the diverse collaborations there and to further strengthening the synergies within the TRA 'Matter'."

About the person:

After studying physics at the University of Münster and the University of Cambridge (UK), Lena Funcke completed her doctorate at the Max Planck Institute for Physics and the LMU Munich at the age of 23. Her doctoral thesis was awarded the Arnold Sommerfeld PhD Prize of the LMU and the Dieter Rampacher Prize, which the Max Planck Society awards annually to the youngest doctoral student with an outstanding doctoral degree. This was followed by a four-year postdoctoral position, initially at the Perimeter Institute for Theoretical Physics in Waterloo (Canada) and then at the Massachusetts Institute of Technology (MIT) in Cambridge (USA), where Funcke published numerous papers in scientific journals.

contact for scientific information:

Jun.-Prof. Dr. Lena Funcke
Transdisciplinary Research Area "Matter"
Helmholtz Institute for Radiation and Nuclear Physics
University of Bonn
Email: lfuncke@uni-bonn.de

Lena Funcke - Jun.-Prof. Dr. Lena Funcke is the new Clausius Professor in the Transdisciplinary Research Area "Matter" at the University of Bonn.
Meike Böschemeyer
© Meike Böschemeyer / University of Bonn